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NEW OR NOTEWORTHY RUSTS ON CARDUACEAE¹

H. S. JACKSON

In connection with a study of the species of *Puccinia* occurring on Carduaceae, which the writer has been making while preparing the manuscript of this group for the rust portion (Vol. 7) of the *North American Flora*, a number of undescribed species have come to light and certain interesting situations encountered.

The original plan to include such material in a series of papers dealing with the species on Carduaceae from all parts of the world² has not been abandoned, but owing to the difficulty of obtaining material of all the extra-limital species, and the prospect of early publication of the remaining numbers of the rust portion of the *North American Flora*, it has seemed best to record the following species and notes at this time.

Puccinia clara nom. nov.

Puccinia hyalina Jackson, Bot. Gaz. 55: 298. 1918. Not *P. hyalina* Dietel, 1905.

In 1918 the writer used the name *Puccinia hyalina* for a species on *Vernonia scariosa* Arn. from Ceylon. The above name is now offered as a substitute, since it has been found that the earlier use of *P. hyalina* by Dietel (cf. Engl. Bot. Jahrb. 37: 99. 1905) for a Japanese *Carex* rust had been overlooked.

PUCCINIA TONDUZIANA Speg. Bol. Acad. Nac. Ci. Cordoba 23: 184. 1919

This species was described from material collected by A. Tonduz, September, 1896, on an unknown arborescent composite, near San Francisco, Costa Rica.

¹ Contribution from the Botanical Department of the Purdue University Agricultural Experiment Station.

² Cf. H. S. Jackson, Carduaceous Species of *Puccinia*.—I. Species occurring on the tribe Vernonieae. Bot. Gaz. 55: 289-312. 1918.

A specimen of the original collection, received some time ago by Dr. Arthur from Spegazzini, has been carefully studied and it is evident that the species is identical with *Puccinia praealta* Jackson & Holway (cf. Jackson, Bot. Gaz. 55: 306. 1918). The latter was described from several collections on *Vernonia triflosculosa* H.B.K. made by E. W. D. Holway in Guatemala and Costa Rica. A comparison of the host of *P. Tonduziana* with *P. praealta* leaves little doubt that they are the same.

Spegazzini, presumably on account of the character of the sorus, mistook the colorless uredospores for aeciospores, and described aecia and telia only for the species. His specimens are considerably older than most of the Holway collections and show some sori on the under surface of the leaves, while many of the epiphyllous sori are empty and their deep-seated origin is not as evident.

Puccinia subdecora Sydow & Holway; Sydow, Ann. Myc. 1: 17.
1903

With this *Puccinia*, which occurs in the west on *Coleosanthus grandiflorus* (Hook.) Kuntze, an *Aecidium* is sometimes associated, and for a time it was thought that it was a long-cycled *autenu-Puccinia*. When the final study of this species was made, however, the writer became convinced that the aecia belonged to a heteroecious rust, on account of the fact that no uredinia developed in certain collections on which the aecia were well past maturity, and because of differences in distribution. Ten aecial collections are in the Arthur herbarium from Colorado, Arizona, and New Mexico, while only five uredinal or telial collections have been made in Colorado and Utah.

A careful search was therefore made for evidence as to the type of life history of this species. A. O. Garrett made a uredinal collection of this species June 22, 1905, at Mill Creek Canyon, Salt Lake County, Utah. The sori in this collection are confined to the stems of young shoots and occur just below the surface of the ground. A careful study of this collection has revealed the presence of a few pycnia associated with these uredinia, indicating that this species is a brachy-form referable to the genus *Bullaria* of the Arthurian classification. With reference to this collection Mr.

Garrett wrote (in litt. Jan. 21, 1919): "I pulled up some of the plants of the *Coleosanthus* for another purpose and noticed the sori on the stems next the roots and entirely invisible from the surface of the ground." This observation, together with the finding of pycnia on the collection referred to, suggests that the life history of many more species of *Puccinia* could be determined if collections could be made early in the season as the plants are coming through the ground.

The aecia mentioned above have since been described as *Aecidium arcularium* Arth. (cf. Bull. Torrey Club 47: 478. 1920).

PUCCINIA KUHNIAE Schw.

A careful study of the common rust on *Kuhnia* in comparison with the species on closely related hosts has resulted in the conviction that *Puccinia Brickelliae* Pk. and *P. Barroetiae* Syd. should be considered synonymous with *P. Kuhniae*. The hosts of the three species are very closely related and there is no essential difference between the rusts. The determination of the life history of this species as a *brachy-Puccinia* is based entirely on cultures made by Dr. Arthur (cf. Jour. Myc. 12: 23. 1906 and Mycologia 1: 23. 1909), no field collections of pycnia associated with uredinia having been made.

The type locality for this species was recorded by Schweinitz as Bethlehem, Pennsylvania. Since this is a western rust, the most eastern locality of any recent collection being in Indiana, there is some doubt whether the type collection is from Pennsylvania as stated. It is possible that Schweinitz made this collection in Indiana, as it is known that at one time he traveled as far west as Hope, Indiana.

The synonymy, etc., of the species, according to this interpretation, is as follows:

PUCCINIA KUHNIAE Schw. Trans. Am. Phil. Soc. II 4: 296. 1832

Puccinia Brickelliae Peck, Bull. Torrey Club 12: 34. 1885.

Dicaeoma Brickelliae Kuntze, Rev. Gen. 3³: 468. 1898.

Dicaeoma Kuhniae Kuntze, Rev. Gen. 3³: 469. 1898.

Puccinia Barroetiae Sydow, Monog. Ured. 1: 28. 1902.

Bullaria Kuhniae Kern, Trans. Am. Microsp. Soc. 32: 65. 1913.

ON CARDUACEAE [EUPATORIEAE] :

Barroetia sp., *Coleosanthus (Brickellia)* sp., *Kuhnia* sp.

TYPE LOCALITY: "Bethlehem, Pennsylvania," on *Kuhnia* sp., probably error for Indiana.

DISTRIBUTION: Indiana to Montana and Arizona, south to Texas and southern Mexico.

***Puccinia redempta* sp. nov.**

O. *Pycnia* unknown.

II. *Uredinia* hypophyllous, scattered or sometimes crowded and more or less confluent, roundish or elliptic, 0.5-1 mm. across, tardily naked, pulverulent, chestnut-brown, ruptured epidermis cinereous, conspicuous; urediniospores globoid or ellipsoid, somewhat irregular, 23-27 by 26-32 μ ; wall dark cinnamon-brown, 1.5-2 μ thick, moderately echinulate, the pores 2, approximately equatorial.

III. *Telia* hypophyllous, scattered, roundish, 0.5-0.8 mm. across, tardily naked, pulverulent, chocolate-brown, ruptured epidermis cinereous, conspicuous; teliospores ellipsoid, somewhat irregular, 30-35 by 43-58 μ , rounded at both ends, slightly constricted at septum; wall chestnut-brown, 3-4 μ thick, slightly thickened at apex, 5-7 μ , concolorous or slightly lighter in color at apex, smooth; pedicel colorless, flexuous, short, deciduous or equalling the spore, often attached obliquely.

ON CARDUACEAE [EUPATORIEAE] :

Eupatorium atriplicifolium Lam., on bank, Road from town to Highbush, Tortola, West Indies, Feb. 13-17, 1913, N. L. Britton and J. A. Shafer, phan. spec. no. 795 (type).

The specimen on which this species is based is fairly ample and was obtained from a specimen in the phanerogamic herbarium at the New York Botanical Garden by the writer in 1917.

It belongs to the smooth-spored group of *Eupatorium* Puccinias and is apparently most closely related to *P. pachyspora* Diet. and *P. Eupatoriæ* Diet., differing from them both in the slightly thickened apex and from *P. Eupatoriæ* in the much broader spores. The urediniospores are not compressed laterally as in *P. pachyspora* and *P. Kuhniae* Schw.

PUCCINIA TOLIMENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. 5: 516.

1913

This species of *micro-Puccinia* was described from a single collection made by E. Mayor on *Eupatorium* sp., near Soledad in the Central Andes, Department of Tolima, Colombia, Oct. 6, 1910 [No. 64]. Three collections were made by E. W. D. Holway in Guatemala, one on *Eupatorium pansamalense* Robinson (Holway 802) and two on *Eupatorium* sp. indet. (Holway 22,806).

On July 22, 1917, a collection of a short-cycled *Puccinia* was made by the writer, in company with H. H. Whetzel and E. F. Hopkins, on *Eupatorium urticaefolium* Reichard, in Bergen swamp, Genessee County, New York. After careful study it has been decided to assign this collection to the above-named species. The distribution, from central New York to Colombia, South America, in isolated localities, suggests that it should be found also in other places.

Puccinia Parthenices sp. nov.

II. Uredinia not seen; urediniospores in the telia obovate or ellipsoid, 16–23 by 24–26 μ , slightly flattened laterally; wall light cinnamon-brown, 1.5–2.5 μ thick, very finely and closely echinulate, appearing smooth when wet, the pores 2, equatorial.

III. Telia hypophyllous, rarely epiphyllous, round, 0.4–0.8 mm. across, early naked, compact, pulvinate, blackish-brown, ruptured epidermis not conspicuous; teliospores obovate, oblong or ellipsoid, 20–26 by 32–45 μ , rounded or obtuse above, rounded below, slightly constricted at septum; wall light chestnut-brown, 1.5–2.5 μ thick, apex thickened 7–9 μ by a broad semi-hyaline umbo, similarly thickened over pore or lower cell at septum, smooth; pedicel colorless, firm, once to thrice length of spore.

ON CARDUACEAE [HELIANTHEAE] :

Parthenice mollis A. Gray, Ft. Lowell, Arizona, Oct. 24, 1903,

J. J. Thornber 1029, comm. L. N. Goodding (type); Babo-quivari Mts., Arizona, Oct. 24, 1919, L. N. Goodding 43.

This species was separated from specimens in the Arthur herbarium tentatively assigned to *P. Parthenii* Arth. It differs from that species as now interpreted in both urediniospore and teliospore characters. The urediniospores in *P. Parthenii* are globoid or ellipsoid, 20–23 by 23–32 μ , with walls 3–3.5 μ thick, and the teliospores are ellipsoid, 28–32 by 38–48 μ , with walls 4–5 μ thick.

PUCCINIA PARTHENII Arth. Bull. Torrey Club 37: 570. 1910

This name was based on *Uredo Parthenii* Speg., which was described in 1899 from a uredio on *Parthenium Hysterophorus* L. Telia were found by Dr. Arthur on two collections on *P. argentatum* A. Gray made by F. E. Lloyd in Mexico. With these collections were included one uredinial collection on *P. Hysterophorus* from Mexico State (Holway 3228) and one on *P. incanum* H.B.K. from Texas (Tracy & Earle 324a).

A recent study made by the writer has led to the conclusion that two distinct species were probably included. The urediniospores of the collection on *P. Hysterophorus* are quite different from those on *P. argentatum*. On the former they are obovate or triangular, 20–24 by 24–28 μ , with walls 1.5–2.5 μ thick, minutely and sparsely echinulate, the pores 3, one in apex and two subequatorial, while on the latter they are globoid or ellipsoid, 20–23 by 23–32 μ , the walls 3–3.5 μ thick, finely and moderately echinulate, the pores 2 or 3, approximately equatorial.

Parthenium Hysterophorus, as noted above, is the type host for *Uredo Parthenii* Speg. Unfortunately this has not been seen, and it has not been possible to determine with certainty whether or not the uredinial collection made by Holway in Mexico is identical. It seems best, however, to exclude *Uredo Parthenii* Speg. from *Puccinia Parthenii* Arth. for the present and to tentatively assign to it the Mexican collection on *P. Hysterophorus*. The collection made by Lloyd at Mazapil, state of Zacatecas, Mexico, March 27, 1908, on *P. argentatum* should be taken as the type of *Puccinia Parthenii* Arth. as emended.

PUCCINIA ADDITICIA Jackson & Holway

This name was published by Dr. Arthur at our request as a substitute for the name *P. Coreopsisidis* Jackson & Holway, which was based on a Guatemalan collection determined as on *Coreopsis mexicana* (DC.) Hemsl. It happened that the name *P. Coreopsisidis* was used by Miss E. Wakefield for an entirely different rust (a micro-*Puccinia*) on *Coreopsis* from Uganda, tropical Africa, four months previously (cf. Bull. Misc. Inf. Kew 1918: 209. Aug. 1918).

Recently the writer had occasion to compare *P. additicia* with

P. Electrae Dietel & Holway and found that the two species are identical. *P. Electrae* was based on a collection made by E. W. D. Holway in Oaxaca, Mexico, the host for which was determined as *Electra Galeottii* A. Gray. The genus *Electra* DC. 1836 (not *Electra* Noron., or *Electra* Panz.) is now considered identical with *Coreopsis*. Furthermore, S. F. Blake (Cont. Gray Herb. N. S. 52: 55. 1917) has recently shown that *C. mexicana* and *Electra Galeottii* are both synonyms of *Coreopsis mutica* DC.

The following is the correct synonymy, etc., of the species:

PUCCINIA ELECTRAE Dietel & Holway; Holway, Bot. Gaz. 31: 333.
1901

Puccinia Coreopsisidis Jackson & Holway; Arth. Am. Jour. Bot. 5:

536. Dec. 1918; not *P. Coreopsisidis* Wakefield, Aug. 1918.

Puccinia additicia Jackson & Holway; Arth. Bull. Torrey Club 48: 32. 1921.

ON CARDUACEAE [HELIANTHEAE]:

Coreopsis mutica DC. (*C. mexicana* Hemsl., *Electra Galeottii* A. Gray), Oaxaca and Guatemala.

TYPE LOCALITY: Oaxaca, Mexico, on *Electra Galeottii*.

DISTRIBUTION: Southern Mexico and Guatemala.

***Puccinia turgidipes* sp. nov.**

II. Uredinia not seen; urediniospores in the telia, strongly compressed laterally, when viewed with pores in optical section, oblong, 16–18 by 26–29 μ , when in face view, subcircular, 24–27 by 26–29 μ ; wall dark cinnamon-brown, 2.5–3 μ thick, moderately and prominently echinulate, the pores 2, opposite and equatorial.

III. Telia amphigenous, scattered, round, small, 0.2–0.5 mm. in diameter, early naked, becoming pulverulent, blackish-brown, ruptured epidermis not noticeable; teliospores globoid or broadly ellipsoid, 30–32 by 32–38 μ , rounded at both ends, not constricted at septum; wall chestnut-brown, 3–4 μ thick, thickened at apex to 6 μ , as well as over pore of lower cell near septum, smooth; pedicel colorless, once to twice length of spore, with thick walls above, becoming abruptly inflated, 12–24 μ from point of attachment.

ON CARDUACEAE [HELIANTHEAE]:

Viguiera deltoidea Parishii (Greene) Vasey & Rose, Estrella Mts. near Maricopa, Arizona, Oct. 30, 1919, L. N. Goodding 48.

This species is easily distinguished from all other Carduaceous rusts, which we have studied, by the strongly compressed character of the urediniospores and the inflation of the pedicels of the teliospores when wet.

The host was determined by Dr. S. F. Blake.

Puccinia triannulata (Berk. & Curt.) comb. nov.

Uromyces triannulatus Berk. & Curt.; Berkeley, Grevillea 3: 56. 1874.

Puccinia mirifica Dietel & Holway; Dietel, Erythea 3: 79. 1895.
Caeomusus triannulatus Kuntze, Rev. Gen. 3³: 451. 1898.

Dicaeoma triannulatum Arth. Résult Sci. Cong. Bot. Vienne 346. 1906.

Through the courtesy of Dr. R. Thaxter, I have had the opportunity of examining a fragment of the type of *Uromyces triannulatus* Berk. & Curt. from the Curtis Herbarium at Harvard University. A second fragment was obtained from the Kew Herbarium by Dr. J. C. Arthur. Both bear the same number, 2270. The specimen from the Curtis Herbarium is labeled as follows: " *Uredo triannulata* B. & C. on *Borrichia frutescens* Santee Canal (?) S. C., June 1848. Ravenel 758." The specimen from Kew is labeled, " *Uromyces triannulatus* B. & C. in *Borrichia frutescens* Car. Inf."

An examination of these specimens leaves no doubt that *Uromyces triannulatus* was based on the uredinial stage of the species later described as *Puccinia mirifica* Dietel & Holway and now known to occur on *B. frutescens* from South Carolina, Florida, and Texas, and on *B. arborescens* from Florida, the Bahamas, and Bermuda.

Pycnia occur with the uredinia in several collections, leaving no doubt that this is a true *brachy-Puccinia* referable to the genus *Bullaria* in the classification proposed by Dr. Arthur.

PUCCINIA BALSAMORRHIZAE Peck

When preparing the manuscript of this species for the *North American Flora*, two points of interest were noted which seem worthy of record at this time.

A comparison of the type with that of *P. Wyethiae* Peck re-

sulted in the conclusion that there was no essential difference between the two. *Balsamorrhiza* and *Wyethia*, the host genera of the two species, are very closely related, and the distribution of *P. Balsamorrhizae* includes that of *P. Wyethiae*.

The life history of this species has been unknown; no collections of aecia have ever been made to our knowledge on either host. In May, 1919, the writer made a collection of uredinia on young leaves of *Balsamorrhiza* sp. at The Dalles, Oregon, which, when studied, showed a few pycnia associated with the uredinia, which occurred in elongated groups along the petioles and the midribs of the leaves. The pycnia are few, gregarious, inconspicuous, orange-yellow, flask shaped, 70–100 by 100–130 μ , the ostiolar filaments projecting slightly. This indicates that the species is a *brachy-Puccinia* referable to the genus *Bullaria* of the classification proposed by Dr. Arthur.

Following is the full synonymy of this species as interpreted above:

Puccinia Balsamorrhizae Peck, Bull. Torrey Club 11: 49. 1884

Trichobasis Balsamorrhizae Peck, Bot. Gaz. 6: 276. 1881.

Uredo Balsamorrhizae DeToni; Saccardo, Syll. Fung. 7: 842. 1882.

Trichobasis Wyethiae Peck, Bot. Gaz. 7: 45. 1882.

Puccinia Wyethiae Peck; Harkness, Bull. Cal. Acad. Sci. 2: 442. 1887.

Dicaeoma Balsamorrhizae Kuntze, Rev. Gen. 3³: 468. 1898.

ON CARDUACEAE [HELIANTHEAE]:

Balsamorrhiza sp., *Wyethia* sp.

TYPE LOCALITY: [Salt Lake City], Utah, on *Balsamorrhiza macrophylla*.

DISTRIBUTION: Colorado, Utah, and Montana to British Columbia and California.

Puccinia vaga sp. nov.

II. Uredinia hypophylloous, becoming somewhat amphigenous, scattered, round, small, 0.2–0.4 mm. in diameter, early naked, pulvululent, cinnamon-brown, ruptured epidermis conspicuous; urediniospores globoid or broadly ovoid, 21–24 by 23–26 μ ; wall

light cinnamon-brown, thin, 1-1.5 μ , moderately and prominently echinulate, the pores 2, opposite and equatorial.

III. Telia amphigenous, scattered, round, small, 0.2-0.5 mm. in diameter, early naked, pulvinate, becoming somewhat pulverulent, blackish-brown, ruptured epidermis evident; teliospores broadly or narrowly ellipsoid, 23-26 by 27-48 μ , rounded at both ends, slightly constricted at septum; wall reddish chocolate-brown, concolorous, medium-thick, 3-4 μ , slightly thicker above, 4-5 μ ; pedicel colorless, about twice length of spore.

ON CARDUACEAE [HELIANTHEAE]:

Verbesina sp., Cuernavaca, Morelos, Mexico, Jan. 1908, E. W. D. Holway (type).

This species appears to differ sufficiently from other *Verbesina* rusts to warrant specific rank. It is perhaps most closely related to *Puccinia abrupta* Dietel and *P. Verbesinae* Schw. It differs from the former in the less thickened apex of the teliospores and in urediniospore characters. From the latter it differs in the concolorous teliospore wall and the thin-walled urediniospores.

The *Verbesina* rusts have proven to be a difficult group and further study based on more ample material will probably result in a realignment of some of the species. The following key will serve to indicate how the North American species have been separated for the *North American Flora*:

Telia only in the life history.

P. ferox D. & H.

Aecia or uredinia or both in life history.

Teliospore-wall not over 7 μ thick at apex.

Telia early naked.

Teliospore-wall lighter at apex, uredinal wall 1.5-2 μ .

P. Verbesinae Schw.

Teliospore-wall concolorous, uredinal wall 1-1.5 μ .

P. vaga Jackson

Telia long covered by epidermis.

P. irregularis Dietel

Teliospore-wall more than 7 μ thick above.

Teliospores typically rounded below.

P. abrupta Dietel

Teliospores typically narrowed below.

Teliospore-wall laminate.

P. invelata Jackson

Teliospore-wall not noticeably laminate.

P. cognata Sydow

COLEOSPORIUM ARNICALE Arth. and PUCCINIA NUDA Ellis & Ev.

Coleosporium Arnicale Arth., described in 1907, was based on a single collection made by W. N. Suksdorf in Falcon Valley, Wash-

ington, Oct. 30, 1901. The host was originally identified as *Arnica foliosa* Nutt., but interpreted by Arthur as *A. cana* Greene. No other collections of a *Coleosporium* on *Arnica* have since been received in this laboratory and there has been some doubt as to the validity of the species. A year or two ago the writer, while working in the mycological herbarium of the New York Botanical Garden, had occasion to examine the type specimen of *Puccinia nuda* Ellis & Ev. This was also described as occurring on *Arnica foliosa* and was collected by Suksdorf (No. 200) in the same locality July 30, 1885. On the herbarium sheet containing the specimen of *P. nuda* there is a second collection of rust on the same host made at the same place and date (Suksdorf, No. 199). Ellis at the time he studied these specimens evidently supposed that the latter collection bore the aecidium of *P. nuda*, since the manuscript sheet of the original description in Ellis's handwriting (pasted on the herbarium sheet with the specimens) included a description of the rust on this collection as an *Aecidium*. When he published *P. nuda*, however, Ellis omitted the aecial description or any mention of the second collection. An examination of this made recently shows that it is unquestionably the uredinia of a *Coleosporium* identical with the type of *C. Arnicale* Arth. and on the same host.

More recently the writer has had occasion to study in detail the type of *Puccinia nuda*. This species is also known only from the type locality and collection. A few days previously *Puccinia Hemizoniae* Ellis & Tracy had been studied and the close resemblance between the two species was at once noted. As a result of this study the conclusion was reached that they are identical, and that the host of *P. nuda* is probably not *Arnica*, but a species of *Madia*, *Hemizonia*, *Hemizonella*, or some close relative of these.

Puccinia Hemizoniae (including *P. Madiae* Sydow) occurs on the same group of hosts as *Coleosporium Madiae* Cooke, and on account of the conclusion just recorded with reference to the *Puccinia*, the possibility that *Coleosporium Arnicale* was identical with *C. Madiae* at once suggested itself.

A comparison of the two species has resulted in the conviction that the former should be considered a synonym of the latter, and

the host, which is identical with the host for *Puccinia nuda*, is probably also *Madia*, *Hemizonia*, *Hemizonella*, or some close relative.

The synonymy, etc., of the two species, according to the interpretation above, is as follows:

COLEOSPORIUM MADIAE Cooke, Grevillea 7: 107. 1879

Stichospora Madiae Sydow, Ann. Myc. 2: 30. 1904.

Coleosporium Arnicale Arth. N. Am. Flora 7: 94. 1907.

ON CARDUACEAE [HELIANTHEAE]:

Anisocarpua, *Centromadia*, *Harpaecarpus*, *Hemizonia*, *Madaria*, *Madia*, *Zonanthemus*.

TYPE LOCALITY: Sierra Nevada, California, on *Madia Nuttallii*.

DISTRIBUTION: British Columbia to central California.

PUCCINIA NUDA Ellis & Ev., Jour. Myc. 3: 57. 1887

Puccinia Hemizoniae Ellis & Tracy, Jour. Myc. 7: 43. 1891.

Puccinia Lagophyllae Dietel & Holway; Dietel, Erythea 1: 250. 1893.

Dicaeoma Hemizoniae Kuntze, Rev. Gen. 3³: 469. 1898.

Dicaeoma nudum Kuntze, Rev. Gen. 3³: 469. 1898.

Puccinia Madiae Sydow, Monog. Ured. 1: 121. 1902.

ON CARDUACEAE [HELIANTHEAE]:

Calycadenia, *Hemizonia*, *Lagophylla*, *Madaria*, *Madia*.

TYPE LOCALITY: Falcon Valley, Washington, on "Arnica foliosa"; error for *Madia* (?) sp.

DISTRIBUTION: Washington to central California; also in South America.

PUCCINIA MELAMPODII Dietel & Holway

A group of short-cycled species of *Puccinia* occurring in sub-tropical regions of North America on a number of Carduaceous hosts of the tribe Heliantheae have proven to be very puzzling. These include especially the following:

P. Melampodii Dietel & Holway, on *Melampodium divaricatum*, from Guatemala and Morelos.

P. Synedrella P. Henn., on *Synedrella nodiflora*, from the West Indies and Panama; also in South America.

P. Zinniae Sydow, on *Zinnia tenuiflora*, from Jalisco.
P. Diaziana Arth., on *Ximenesia encelioides*, from Coahuila.
P. Tridacis Arth., on *Tridax procumbens*, from Cuba.
P. Eleutherantherae Diet., on *Eleutheranthera ruderalis*, from the West Indies and Panama; also in South America.
P. Tetranthi Sydow, on *Tetranthus hirsutus*, from Haiti.

It will be noted that each one is known in North America on a single host species, and all are on separate genera. To these should be added unnamed forms on *Parthenium Hysterophorus* from southern Texas and on *Spilanthes oleracea* from Martinique. The latter might possibly be properly referred to *Puccinia Spilanthicola* Mayor.

A careful comparison of these forms has failed to reveal any method by which they can be separated on a morphological basis and it has been decided to treat them as one species in the *North American Flora*. It is possible, indeed quite probable, that they are biologically distinct and may even have had, in part, an independent origin. It seems reasonable to suppose that collectively or independently they are correlated with one or more cyperaceous rusts occurring in the same region, which have aecia on these or related hosts, but the genetic connection of which has not yet been determined.

It should be pointed out that this species is very much like *P. Emiliae* P. Henn. (see p. 119), which occurs on members of the tribe Senecioneae with a similar distribution. It is also related to *Puccinia Silphii* Schw., which occurs on *Silphium* sp. in temperate regions, but which has somewhat narrower spores.

The synonymy, etc., is as follows:

Puccinia Melampodii Dietel & Holway; Holway, Bot. Gaz. **24**: 32. 1897

Puccinia solida Berk. & Curt. Jour. Linn. Soc. **10**: 356. 1869.
Not *P. solida* Schw. 1839.

Puccinia Synedrella Lagerh.; Sydow, Ured. 376, hyponym. 1890.
Puccinia Synedrella P. Henn. Hedwigia **37**: 277. 1898.

Dicaeoma cubense Kuntze, Rev. Gen. **3**: 466. 1898.

Dicaeoma Synedrella Kuntze, Rev. Gen. **3**: 470. 1898.

Puccinia Zinniae Sydow, Monog. Ured. 1: 188. 1902.

Puccinia Diaziana Arth. Bot. Gaz. 40: 203. 1905.

Puccinia Tridacis Arth. Bull. Torrey Club 33: 516. 1906.

Dasyspora Synedrella Arth. Résult Sci. Congr. Bot. Vienne 347. 1906.

Puccinia Eleutherantherae Dietel, Ann. Myc. 7: 354. 1909.

Puccinia Tetrathi Sydow, Ann. Myc. 17: 33. 1919.

Micropuccinia Synedrella Arth. & Jackson; Arth. Bull. Torrey Club 48: 41. 1921.

ON CARDUACEAE [HELIANTHEAE]:

Hosts as above.

TYPE LOCALITY: Cuernavaca, Mexico, on *Melampodium [di-varicatum]*.

DISTRIBUTION: Central Texas to Panama and the West Indies; also in South America.

Puccinia solida B. & C. is based on a collection by Charles Wright, 1856-1857, in "Cuba Orientale" on an unknown composite, now interpreted as *Eleutheranthera ruderalis*. *Dicaeoma cubense* is based on the same collection.

It is very probable that there are other forms in South America and possibly in similar regions in other parts of the world which should be included here. It has, however, been impossible, up to the present time, to bring together all the material which would be needed in making such a comprehensive study, and it should be recognized that the treatment as outlined above is tentative only.

Puccinia Flaveriae sp. nov.

O. Pycnia unknown, probably not formed.

III. Telia amphigenous or caulicolous, gregarious on discolored spots, or extending for considerable distances on stems, round, small, 0.2-0.5 mm. in diameter, tardily naked, chestnut-brown, pulvinate, the caulicolous sori long covered by the cinereous epidermis. ruptured epidermis of foliicolous sori conspicuous; teliospores irregularly ellipsoid, clavate or cylindric, 15-19 by 32-50 μ , often bent to one side, rounded, obtuse or more or less acute above. rounded or narrowed below, not constricted at septum; wall light cinnamon-brown, 1.5-2 μ thick, much thicker above, 5-10 μ , smooth; pedicel one half length of spore or shorter, firm, concolorous with base of spore.

ON CARDUACEAE [HELENIEAE]:

Flaveria campestris J. R. Johnston (*F. angustifolia* A. Gray),
Manhattan, Kansas, Sept. 15, 1893, M. A. Carleton (type).

The collection on which this species is based has been included with *Puccinia Asteris* Duby in the Arthur Herbarium, but it does not seem to be that species, and an attempt to assign it elsewhere with any degree of certainty has not been successful. It appears to be a *Micropuccinia* and there are no species on related hosts with which this can be logically placed. It differs from *P. Actinellae* in the irregular lighter-colored spores borne in sori which arise just below the epidermis and remain long covered. It is most nearly like a collection on *Hymenopappus carolinensis* (Lam.) Porter, which has been assigned to *P. Grindeliae* Pk.

PUCCINIA MILLEFOLII Fuckel

This species is known from a few collections on *Achillea Millefolium* L. from California, Montana, and Oregon, and one on *A. lanulosa* Nutt. from New Mexico. A careful comparison of this species, using both American and European material, has failed to reveal any morphological basis for separating this from *P. conferta* Diet. & Holway, which occurs on various species of *Artemisia* from North Dakota to northern Texas and westward to Washington and northern California, also in Europe. The hosts are closely related and there seems no good reason for keeping them separate for purposes of the *North American Flora*.

The synonymy is as follows:

PUCCINIA MILLEFOLII Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 55.
1870

Puccinia conferta Dietel & Holway; Dietel, Erythea 1: 250. 1893.

Puccinia recondita Dietel & Holway; Dietel, Erythea 2: 128.

1894. Not *P. recondita* Rob. 1857.

Puccinia artemisiicola Sydow, Monog. Ured. 1: 14. 1902.

Dasyspora conferta Arth. Résult Sci. Congr. Bot. Vienne 346.
1906.

Dasyspora Millefolii Arth. Résult Sci. Congr. Bot. Vienne 347.
1906.

Micropuccinia conferta Arth. & Jackson; Arth. Bull. Torrey Club
48: 40. 1921.

Micropuccinia Millefolii Arth. & Jackson; Arth. Bull. Torrey Club
48: 41. 1921.

Puccinia Emiliae P. Henn. Hedwigia 37: 278. 1898

Puccinia Emiliae, a typical *micro-Puccinia*, is based on a collection made by Dr. J. Urban in Jamaica on *Emilia sagittata* (Vahl) DC. It is also known on *E. sonchifolia* (L.) DC. and *Neurolaena lobata* (L.) R. Br., having a distribution from southern Florida, Panama, and the West Indies.

In 1907, Rev. J. M. Bates collected at Red Cloud, Nebraska, a short-cycled *Puccinia* on the cultivated *Calendula officinalis* L. and *Dimorphotheca cuneata* DC. This rust has since been collected on the former host at Guanabaroa, Cuba, by J. R. Johnston; Urbana, Illinois, by H. W. Anderson, and at New Castle, Indiana, by H. F. Dietz. The last collection was found on plants grown in the greenhouse, the others being garden collections. The rust had been tentatively assigned to *Puccinia recedens* Syd. in the Arthur Herbarium and the collection on *Dimorphotheca* was issued under that name in Bartholomew's North American Uredinales 1863.

Recently, while studying the short-cycled *Puccinia*s of this group, the writer found that, while there was some variation in the collections on different hosts, there was no sharp distinction between *P. Emiliae* and *P. recedens*. The latter has slightly shorter spores with somewhat thicker walls than the former.

Puccinia recedens, however, is a northern rust occurring on *Senecio* species and having a range extending from southern New York to West Virginia along the Atlantic coast and across the continent to the mountains of Oregon and Alberta. This species is interpreted, on account of the morphology of the teliospores and host relationships, as a correlated species with *Puccinia (Dicaeoma) Eriophorii* Thüm., which has aecia on *Senecio* and telia on *Eriophorum* with a quite similar range in North America.

Puccinia Emiliae, on the other hand, is apparently native of subtropical regions. For these reasons it has been decided to keep the two species separate and to assign to *P. Emiliae* the collections

noted above on the cultivated hosts *Calendula* and *Dimorphotheca*. It is suggested that *P. Emiliae* is probably correlated with some species of subtropical cyperaceous *Puccinia* (several of which have been described), the aecial connection for which is as yet unknown.

The collections on *Dimorphotheca* and *Calendula* add another rust to the increasing list of diseases of floricultural crops, which may, under certain conditions, become of considerable economic importance. Since these hosts are annuals, propagated by seed only, it is not anticipated that the rust will prove as destructive as those occurring on hosts propagated by cuttings.

Uredo abdita sp. nov.

II. Uredinia obscured by dense tomentum of host, apparently amphigenous, round or oval, large, 0.5-1.5 mm. in diameter, early naked, very pulverulent, chestnut-brown, ruptured epidermis not conspicuous; urediniospores usually considerably flattened laterally, with pores in face view globoid or broadly ellipsoid, 26-29 by 26-32 μ , with pores in optical section oblong or narrowly ellipsoid, 20-24 by 26-32 μ ; wall chestnut-brown, thick, 2.5-3 μ , moderately but very finely echinulate, appearing smooth when wet, the pores 2, superequatorial.

ON CARDUACEAE [SENECIONEAE] :

Senecio Cineraria DC. (cultivated), Catalina Island, California, Aug. 1912, E. Bethel (type).

This species differs in pore characters and markings of the urediniospores from other *Senecio* rusts which we have been able to obtain for examination.

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